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GEOLOGY AND PALEONTOLOGY.

The Paleozoic Reptilian Order Cotylosauria.—A paper was read before the American Philosophical Society, November 15, 1895,[1] by Prof. E. D. Cope, on the reptilian order Cotylosauria. The following is an abstract of the characters of the order.

Quadrate bone united by suture with the adjacent elements. Temporal fossa overroofed by the following elements: Postfrontal, postorbital, jugal, supramastoid, supratemporal, quadratojugal. Tabular bone present. Vertebræ amphicoelous; ribs one headed. Episternum present. Pelvis without obturator foramen.

This order is of great importance to the phylogeny of the amniote Vertebrata. The structure of the temporal roof is essentially that of the Stegocephalous Batrachia, while the various postorbital bars of the amniote Vertebrata are explained by reference to the same part of its structure.

The palatal elements in this order are more or less in contact on the middle line, and the pterygoids diverge abruptly from this point, and return to the quadrate. The occipital condyle is single, and does not include exoccipital elements (unknown in Elginia).

Intercentra are present in Pariasauridæ, Diadectidæ and Pariotichidæ, and they are wanting in Elginiidæ. The hyposphen-hypanterum articulation is present in the Diadectidæ, but is wanting in the Elginiidæ and Pariasauridæ.

The scapular arch is best known in Pariotichidæ, Pariasauridæ[2] and Diadectidæ. In the two former there is a T-shaped episternum, over which are applied the median extremities of the clavicles; and there are well-developed coracoid and praecoracoid. In Diadectidæ[3] (probably genus Empedias) the episternum is articulated by suture with the clavicles.

In the Proceedings of the American Philosophical Society, 1892, p. 279, in a paper on "The Phylogeny of the Vertebrata," I wrote as follows: "Moreover, the Pelycosauria and the Procolophonina have the interclavicle, which is an element of membranous origin, while in the Prototheria we have the corresponding cartilage bone, the episternum. This element is present in the Permian order of the Cotylosauria which is nearly related to the Pelycosauria." The examination of the sternal region in Pariotichus has led me to the conclusion that the episternum and interclavicle are present and fused together in that genus, and also to the belief that the episternum is present in the genus Procolophon. The structure is generally similar in the two genera, and I think that Seeley is in error in determining the element in question in Procolophon as the interclavicle only.[4] Gegenbaur pointed out in his *Comparative Anatomy* the different (*i. e.*, membranous) origin of the interclavicle of the Lacertilia, but he included it with the episternum under the same name. The true episternum is not present in the Lacertilia. It is present in the Sauropterygia and Testudinata and probably in all the orders with one postorbital bar, or Synaptosauria, while it is wanting in most or all of the Archosaurian series, and in the Squamata. Whether the element I have referred to in the genus Naosaurus as interclavicle, is that element or the episternum, must remain uncertain until I can see it in place. Its edges are thin, as in the interclavicle of the Lacertilia. Of course, the Reptilian order which is in the line of ancestry in the Mammalian will have an episternum and not an interclavicle only. The Stegocephalia among Batrachia possess an episternum, with, perhaps, an adherent interclavicular layer as in the Testudinata.

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[1] See Proceedings Amer. Philos. Soc., Vol. XXXIV, 1896, p. 436.

[2] Seeley, Philos. Trans. Roy. Soc. London, 1888, p. 89; 1892, p. 334.

[3] Cope, Proceeds. Amer. Philos. Soc., 1883, p. 635.

Seeley describes four sacral vertebræ in Pariasaurus. In Empedias there are but two. The pelvis is without obturator foramen. The humerus has an entepicondylar foramen. The tarsal and carpal elements are incompletely known.

There are palatine teeth in Empedias and Pariasaurus, but none in Elginia; vomerine teeth none.

The inferior surface of the cranium is known in Elginia, Pariasaurus, Empedias and Pariotichus, and has been described as to the first three genera by Newton, Seeley, and myself. Pariotichus displays generally similar characters. There is a pair of posterior nares, and a pair of zygomatic foramina, but no palatine foramen. The palatine elements meet on the middle line, but gape behind. The vomers (prepalatines) are distinct, and are well developed anterior to the palatines. The ectopterygoid is large and has a prominent posterior border. I have stated that in Empedias there are teeth on the vomer. Better preserved specimens of Pariotichus show that the teeth are really borne on the edges of the palatines, which are appressed on the median line in the former genus. Similar palatine teeth are present in Pariasaurus, but are wanting in Elginia. Teeth are also present on the posterior edge of the ectopterygoids in Pariasaurus and Pariotichus, but not in Elginia or Empedias. A character of the American genera is the weakness of the attachment of the basioccipital to the sphenoid. The basioccipital is lost from the only known specimen of Elginia, and the sphenoid projects freely below it in Pariasaurus, The roof of the mouth in this order is a good deal like that of the Lacertilia, lacking the palatine foramen.

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[4] Philos. Transac. Royal Society, 1889, p. 275, Pl. IX, fig. 9.

The order Cotylosauria was defined by me in the AMERICAN NATURALIST for 1880, p. 304, and in 1889 (October). In 1889 (Transac. Roy. Soc. London, p. 292), Prof. Seeley gave it the name Pariasauria. In my *Syllabus of Lectures on Vertebrate Paleontology* (1891, p. 38), I arranged the group as a suborder of the Theromora. In 1892 (*Trans. Amer. Philos. Soc.*, p. 13, Pl. I), I again regarded the Cotylosauria as an order, and described the characters of the skull in three of the genera, and gave figures of them.

Seeley has objected to the reference of the genera Pariasaurus and Empedias to the same order, on the ground that the elements connecting the supraoccipital and the quadrate rest on the occipital elements in the latter, while they are elevated above them in the former. This character would not, however, define orders, as both conditions are found in Lacertilia; but might distinguish families within an order. However, Seeley's description and figure of the occipital region in *Pariasaurus bainii*[5] show that the structure only differs from that of the Diadectidae in the presence of a large foramen between the supraoccipital and exoccipital bones on each side.

The known species of the Cotylosauria range in dimensions from that of the South American Caimans (Chilonyx, Pariasaurus sp.) to that of the smaller Lacertilia, e. g., *Eumeces quinquelineatus* (Isodectes and Pariotichus sp.). They range from the Coal Measures to the Trias, inclusive, and have been found in South Africa, North America and Scotland. A single genus has been found in the Coal Measures of Ohio, which is represented by a species which I called *Tuditanus punctulatus*.[6] It is of small size, and as the maxillary teeth are of equal length, I cannot distinguish it from Isodectes, which belongs to the Pariotichidæ. The other species which were referred to Tuditanus are Stegocephalia.[7] *This is the first identification of a true reptile in the Coal Measures.*

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[5] Philos. Transac. Roy. Soc. 1892, p. 326, Pl. XVIII, Fig. 2.

[6] Transac. Amer. Philosoph. Society, April, 1874, separate p. 11. Report Geol. Survey of Ohio, 1875, Paleontology, p. 302, Plate XXIV, fig. 1 (erroneously named in explanation *Tuditanus longipes*).

[7] Proceeds. Amer. Philos. Soc., 1871, p. 177.

This order embraces, at present, four families, comprising 24 species distributed among 12 genera, as follows: Elginiidae, 1 genus, 1 species; Pariasauridæ, 3 genera, 7 species; Diadectidæ, 5 genera, 9 species; Pariotichidæ 6 genera (of which 3 are new, viz.: Isodectes, Captorhinus and Hypopnous), and 12 species, of which 5 are new. Total, 29 species, 15 genera.—E. D. Cope.

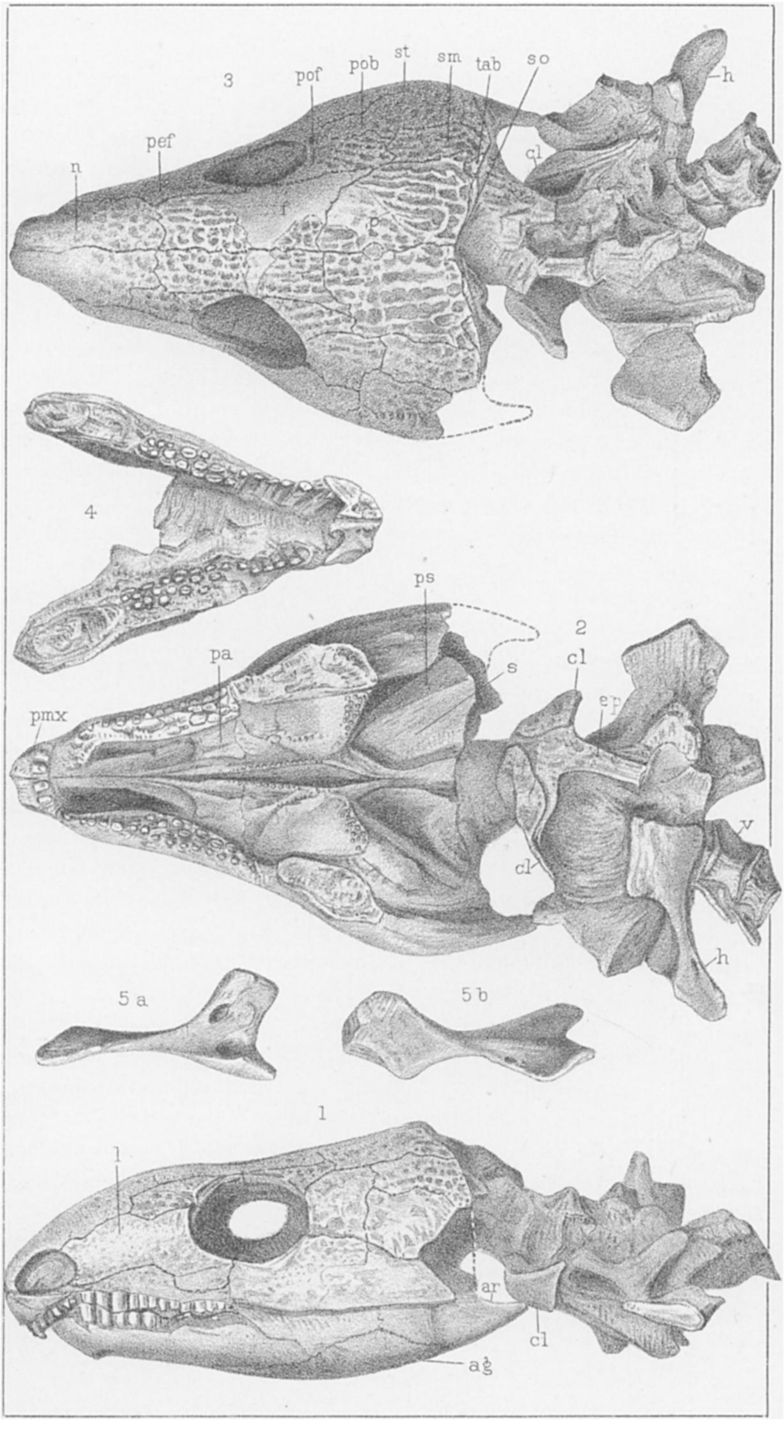
Explanation of Plate VIIa.

Pariotichus aguti Cope. From the Proceeding Amer. Philos. Society, November, 1895. Fig. 1, Skull, from side. Fig. 2, Skull, with angular parts of mandible adherent, cervical vertebrae and scapular arch, from below. Fig. 3, Skull, from above, with cervical vertebrae. Fig. 4, Anterior two-thirds of mandibular arch, with adherent premaxillary bones, from above. Fig. 5, Humerus. *N.*, Nasal bone; *F.*, Frontal; *Pef.*, Prefrontal; *Pof.*, Postfrontal; *P.*, Parietal; *Pmx.*, Premaxillary; *Mx.*, Maxillary; *J.*, Jugal; *Qj.*, Quadratojugal; *St.*, Supratemporal; *Sm.*, Supramastoid; *Tab.*, Tabulare; *So.*, Supraoccipital; *V.*, Vomer; *Pa.*, Palatine; *Par.*, Paroccipital; *Ecp.*, Ectopterygoid; *Ps.*, Pterygoid; *Q.*, Quadrate; *Ce.* Clavicle; *Ep.*, Episternum; *H.*, Humerus.

The Puget Group.—Sir Wm. Dawson confirms the opinion advanced by Dr. G. M. Dawson in 1890 that the formation in the north-western part of the United States to which the name Puget group has been given, extends into British Columbia as far as Burrard's Inlet. This great estuarine deposit extends southward as far as the Columbia River and from the coast line to the Cascade range, within which its beds rise to a height estimated at from 800 to 5000 feet above the level of the sea. They overlie the Cretaceous Chico series in the United States, and its equivalent the Nanaimo formation in Canada. The latest views of paleobotanists and geologists of the United States seem to be that these beds are of Eocene age and that the fossil plants may be best compared with those of the Upper Laramie of the interior plains. In so far as Canada is concerned it has been established that the Upper Laramie beds underlie a formation containing animal fossils of the White River Miocene period, so there can be no doubt as to their Eocene age, and consequently of the Eocene age of the Puget group in Canada.

A further confirmation as to this view of the age of the formation in question is found in a collection of fossil plants from the vicinity of Burrard Inlet. These were referred to Sir Wm. Dawson for identification who sums up the results of his study as follows:

PLATE VII.a.



PARIOTICHUS AGUTI COPE.

"A comparison with the flora of the Upper Cretaceous Nanaimo series shows that the Burrard Inlet species are distinct and of more modern aspect. On the other hand, they are also distinct from those of older Miocene deposits of the Similkamen district and other parts of the interior of British Columbia. Between these they occupy an intermediate position; in this resect corresponding with the Laramie of the interior plains east of the Rocky Mountains. They also resemble this formation in the general facies of the flora, which is not dissimilar from that of the Upper Laramie or Fort Union group."

"We may thus refer these plants to the Paleocene or Eocene, and regard them as corresponding with those of the Atanékerdluk beds in Greenland, the lignitic series of the McKenzie River, and the beds holding similar plants in Alaska."

"This flora thus serves to fill the gap in our western series of fossil plants, namely, that between the Cretaceous and the Lower Miocene." (Trans. Roy. Soc. Can. (2), Vol. I, 1895–'96.)

The Geological Structure of Florida is according to Prof. E. T. Cox, remarkable for its simplicity. The underlying rock is a soft limestone of Upper Eocene age; resting on this are beds of phosphate of lime; and covering the phosphate and limestone is a bed of sand that varies from a few inches to 20 feet and more in depth.

The Eocene limestone is filled with fossil marine shells. It shows no evidence of disturbance and is without a trace of stratification. It has an amorphous structure and is of unknown thickness. The phosphate of lime occurs in detached masses scattered over an area about 20 miles wide, and exending in a belt, follows in general way the trend of the Gulf coast from the northern limits of the state and beyond, to the western edge of the Everglades on the south. The author believes the phosphate to be the result of the mineralization of guano.

The covering of sand is found all over the Peninsula. It has been blown by the winds from the gulf and ocean beaches. Mixed with the sand is clay in the form of fine dust. In several localities the associated clay has been separated from the sand by running water and deposited as kaolin. This kaolin has been tested and found to be of superior quality for the manufacture of the finest porcelain.

Florida is not a level plain. A ridge from 30 to 50 miles wide extends from the northern part of the state to the Everglades, having an elevation of more than 230 feet in some places. From this ridge the land slopes to the Atlantic on the east and the Gulf on the west.

The elevation of the Peninsula was due to that continental force, extended over a vast period of time, which brought the tops of the Rocky

Mountains above the waters of the Pacific. (Trans. Amer. Inst. Mining Engineers.)

The Eocene age of part of Florida was first asserted by Prof. Eugene Smith of Alabama, and this conclusion was confirmed by paleontologic data by Prof. Heilprin, of Philadelphia. Dr. W. H. Dall subsequently delimited exactly the area of these beds with the Neocene and Plistocene beds to the south, east and north of them.

Notes on the fossil Mammalia of Europe Pt. II.—*On the affinities of the Genus Tapirulus, Gervais.*—Tapirulus is one of those aberrant types, where we find a curious assemblage of characters, which to the systematist is a great annoyance, although to the morphologist most instructive.

A superficial examination of the teeth has lead some palæontologists to assign this genus a position near the Tapir. Gervais[1] established this genus on the characters of the lower true molars.[2] He referred *Tapirulus* to the family *Anoplotheriidæ,* which I shall endeavor to prove is its proper position, although this reference on his part I believe was accidental, as he placed in the same family the genus *Adapis.* Gaudry[3] has assigned *Tapirulus* a position near the genus *Tapirus,* and Zittel[4] referred it to the *Suidæ.*

Through the great kindness of Prof. Albert Gaudry, who has so generously allowed me to study so many of the beautiful specimens in the collection of the Jardin des Plantes, I have had the opportunity of examining a skull of *Tapirulus,* in which the greater part of the upper dentition is preserved. On examination of this skull I was at once struck by its close resemblance to that of *Anoplotherium,* and *Dacrytherium.*

The skull in *Tapirulus* is slender and much elongated, the dorsal contour is nearly straight, and the facial portion is strongly compressed and slender. There is no preorbital fossa, as in *Dacrytherium,* and the occiput is high and narrow, like that of *Anoplotherium.* The auditory region very closely resembles that of *Dacrytherium,* the paroccipital process is long, slender and the posttympanic and glenoid processes are applied closely to the external auditory meatus. The brain case in the *Anoplotheriidæ* is much extended anteroposteriorly, being about one-half the total length of the skull in *Dacrytherium.* In *Tapirulus* the cranial portion of the skull is shorter relatively than in *Dacrytherium* and with this decrease in length I observe a greater development of the anterior part of the brain case, which encloses the frontal lobes of the brain. In short the brain of *Tapirulus* as compared with the size of the skull, must have been much larger than in *Dacrytherium*, and this greater development effected especially the frontal region of the brain.

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[1] Comptes Rend. Acad. Sci., 1850, p. 604.

[2] Zoologie et Palæontologie Francaise, p. 173, pl.

[3] Journal de Zoologie, XIV, 1875, p. 5.

[4] Traité de Palæontologie, 1894, p. 338.

As the Suilline type of skull was well established in the Phosphorites or Upper-Eocene of France (*Cebochœrus*), I shall compare the cranium of *Tapirulus* with that of *Cebochœrus*. In the latter genus the brain case is very much reduced with the extremely prominent zygomatic arches; sagittal and lambdoidal crests are very heavy and the occiput is broader than high. The cranial portion of the skull in *Cebochœrus* is much heavier and broader than the facial. All these cranial characters in *Cebochœrus* differ decidedly from those of *Tapirulus* and I enumerate them, so as to prove that *Tapirulus* has no direct affinity with the Suillines. The skull of *Tapirulus* somewhat resembles that of the primitive Selenodonts, (*Cœnotherium*), but it is more slender and its general form more closely resembles that of the *Anoplotheridœ*.

It is, however, the peculiar structure of the teeth, which is the most important consideration in studying *Tapirulus*. It is upon the characters of the teeth that *Tapirulus* has been assigned its various positions in the Ungulata. On a superficial examination of the upper true molars of *Tapirulus*, they exhibit a certain resemblance to those of the Tapir, but studied in detail I shall endeavor to prove that the molars of *Tapirulus* differ fundamentally in their plan from any of the known Lophiodonts. In the first place the external lobes of the superior molars in *Tapirulus* are concave, and not convex as in the true Tapirine molar. Again the transverse crests are straighter and their relation to the external lobes differ from those of the Tapirs tooth. At the junction of the transverse crests and the external lobes there is a strong notch, and in one specimen I can detect a faint trace of the intermediate tubercles.

The superior molars of the *Anoplotheriidœ*. as is well known, have deeply concave external lobes, the protoconule is distinct from the protocone, the latter element being in its primitive bunodont condition. In *Anoplotherium* and *Dacrytherium* the hypocone is selenodont in structure. In other words the form of superior molar found in the *Anoplotheridœ* is a slight modification of the buno-selenodont type, it differs from the exact form of this type in having the hypocone crescentoid.

Now in *Tapirulus* the two external concave lobes of the superior molars have nearly the same structure as those of *Dacrytherium*, and the internal primitive bunodont elements of the crown, have been transformed into crests, this occurred before the *Anoplotherium* type of molar had reached its present stage of evolution. It is then not difficult to derive the form of superior molar found in *Tapirulus* from the true buno-selenodont type, and I believe this to have been the origin of the peculiarly modified molar occurring in *Tapirulus*.

The superior and inferior premolars in *Tapirulus* have the same elongated form so characteristic of the *Anoplotheriidæ* in general, and like the latter group, the canines were not differentiated in form from the anterior premolars. The lower true molars of *Tapirulus* depart widely in structure from those found in any of the known genera of the *Anoplotheridæ*, although like the upper molars they are much specialized and can be derived from a less modified type, which was the common stock of both *Tapirulus* and *Anoplotherium*. A peculiarity in the structure of the lower molars of *Tapirulus* is the presence on each tooth of a well developed third lobe, hypoconulid, which projects posteriorly a considerable distance. The portion of the molar crown anterior to the hypoconulid consists of two high transverse crests, the antero-external termination of the front crest exhibiting a rudiment of the anterior spur, which is so largely developed in all the other genera of the *Anoplotheridæ*. The lower jaw in *Tapirulus* is long and extremely slender and its form closely resembles that of *Dacrytherium*.

In conclusion I believe the natural position of *Tapirulus* is in a subfamily of the *Anoplotheriidæ*, and that both *Tapirulus* and *Anoplotherium* have been derived from a common stock, the ancestral form having had the pure type of buno-selenodont molar. As already shown above, the resemblance in structure of the molars of *Tapirulus* to that of the Tapir is not exact, the Tapirs tooth having been derived direct from the bunodont type (See *Euprotogonia* and *Systemodon*).

III.

On the validity, and systematic position of Mixtotherium Filhol.—The genus *Mixtotherium*[5] is another interesting form, not as aberrant in its characters as *Tapirulus*, but which unites in a certain degree the Suillines and the Anoplotheroids. Prof. Zittel in his "Traité de Palæontologie" does not consider *Mixtotherium* as a good genus, and refers it to the milk dentition of *Diplobune*. I am quite confident that Prof. Zittel is mistaken in this determination, and I shall endeavor to prove that *Mixtotherium* is a valid genus and entirely distinct from either *Diplobune* or *Dacrytherium.*

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[5] Mém. quelques Mam. fossiles, Toulouse, 1882.

The genus *Adiotherium* was described by Filhol in 1884. This genus is referred by Zittel to the milk dentition of *Dacrytherium*, I can not agree with Prof. Zittel on this reference either, as I believe *Adiotherium* to have been based upon the milk dentition of *Mixtotherium.*

The skull in *Mixtotherium* is essentially Suilline, but exhibiting some characters like those of the Anoplotheroids. The form of the brain case is longer and narrower than in *Cebochœrus*, and it closely resembles that of *Acotherulum* which is one of the most primitive of the early Suillines of Europe. The occipital region of the skull in *Mixtotherium* is much broader than high, and is not constricted in the middle as in *Dacrytherium;* the occiput has nearly the exact form of *Acotherulum* and *Cebochœrus.*

In the primitive pigs of the Phosphorites the auditory bullæ are extremely small, in *Mixtotherium* they are large. The basioccipital region of the skull in *Mixtotherium* is rather long and narrow, and like that of *Dacrytherium.* In *Cebochœrus* of the Phosphorites, the peculiarly elongated and constricted snout of the pigs is well differentiated, however, in *Mixtotherium* as well as *Acotherulum* the facial region of the skull is broader and shorter, its form being more as in *Dacrytherium. Mixtotherium* agrees with *Diplobune* and differs from *Dacrytherium* in lacking a preorbital fossa in the maxillary bone. The general form and proportions of the skull in *Mixtotherium* is very much like that of the peculiar American genus, Oreodon.

The dentition of *Mixtotherium* resembles that of the *Anoplotheridæ* in the absence of any diastemas, it differs, however, from this family in the large size of the canines, which in form resembles more those of the Suillines. The superior premolars are normal in form, and not elongated as in the Anoplotheroids. The last upper premolar closely resembles in structure a true molar, it has two external cusps, which are intermediate in structure between the bunoid and selenoid forms. The deuteroconid forms a crest with the antero-intermediate tubercle, the tetastoconid is present, but small and bunoid in structure. The structure of the superior molars of *Mixtotherium* differ from those of *Diplobune* and *Dacrytherium* in the following details; the external crescents are united externally by a prominent mesostyle, which is more constricted than in *Diplobune;* in *Dacrytherium* this portion of the molar is open widely internally.

In the *Anoplotheridæ* the protocone is distinct from the protoconule, whereas in *Mixtotherium* these elements are united and form a well developed protoloph. In *Mixtotherium* the hypocone is selenoid in structure as in *Dacrytherium,* but this cusp is much smaller and it is much less extended internally than in that genus. I emphasize especially the large development of the mesostyle, and the presence of a protoloph, characters of the upper molars of *Mixtotherium* which differs decidedly from those of *Dacrytherium.* The structure of the fourth upper premolar in *Mixtotherium* resembles somewhat that of *Agriochœrus,* but differs from this genus in the presence of the postero-internal cusp. In *Dichodon* Owen, the complication of the fourth upper premolar is carried still further than in *Mixtotherium,* as in *Dichodon* this tooth is completely molariform and selenodont in structure. However, I believe, that *Mixtotherium* has no close affinity with *Dichodon,* as the structure of the skull and dentition in *Dichodon* is quite modernized.

The lower jaw in *Mixtotherium* is rather short and deep below the last lower molar, these characters differ strikingly from those of the *Anoplotheriidœ,* where the jaw is very slender and elongated. The mandibulæ are strongly ankylosed at the symphysis as in the primitive pigs, *Acotherulum* and *Cebochœrus,* this is a character I believe seldom found in the Mammalia outside of the Primates. The last lower premolar in *Mixtotherium* is intermediate in structure between a last milk tooth and permanent molar. It consists of an antero-median cusp, bunoid in form, and posterior to it, of two external crescents and two flattened internal elements. The structure of the inferior true molars is like that of *Dacrytherium.*

It appears to me that the genus *Mixtotherium* is of importance phylogenetically, and demonstrates how closely the Suillines and Anoplotheroids are related. In the characters of the skull and the large development of the canines *Mixtotherium* is more like the pigs, but showing affinities to the Anoplotheroids in the form of the brain case. The structure of the molars, as already shown, resemble very closely those of the *Anoplotheriidœ* and have gone one step further in their specialization by the development of a well defined protoloph.

Schlosser in his paper, "Stammesgeschichte der Hufthiere" speaking of the origin of the Sullines remarks "die Herkunft diese Stammes ist noch in vollständiges Dunkel gehüllt, nur so viel dürfen wir als sicher annehmen, dass derselbe wohl von der gleichen Grundform ausgegangen ist wie der der Suiden." The Oreodonts are considered by Scott to be related to the Anoplotheroids, and if this be the case it is not strange that the skull of *Mixtotherium* resembles that of *Oreodon.* The genus *Protoreodon* of the Uinta or Upper Eocene, has the five lobed superior molar typical of the Anoplotheroids, and the primitive Suillines.

In conclusion, *Mixtotherium* is then a type intermediate between the Suillines and the Anoplotheroids, and has been derived from a common stock, which also gave origin very probably to the Oreodonts.—CHARLES EARLE, Laboratoire de Palæontologie, Jardin des Plantes, Paris.

The Glaciers of Greenland.—Prof. Chamberlin's report on the Geology of Greenland contains the results of his observations of glacier phenomena in the region explored by the Peary auxillary expedition of 1894. The seventeen glaciers visited fall into two classes designated the southern and northern types. The former are distinguished by ending in a slope of moderate declivity, the latter end in abrupt terminal walls which rise to heights of 50 to 150 feet. The author notes here that he is speaking of glaciers that end upon the land. Obviously, those that reach the sea terminate in vertical walls through the breaking away of the ends. Not only are the ends of the glacial tongues vertical, but in some instances the sides are so likewise. To some extent the edge of the ice-cap itself is vertical.

The stratification of these glaciers is remarkable for extent and definiteness. The ice is almost as distinctly bedded as sedimentary rock. The following points are noted by the author:

" In the vertical face there are usually presented two distinct divisions, an upper one of nearly white ice, whose laminations are not conspicuous, from lack of differential coloration, and a lower one discolored by debris, which gives great distinctness to the bedded structure. The lower divisions is divided by very numerous partings, along which are distributed rocky debris, embracing not only sand and silt, but rubble and boulders. Often the amount of this interspread debris is so sligbt as to constitute the merest film, while at other times it reaches a thickness of an inch or two. . . . . . In general, the rocky debris is arranged in very definite and limited horizons leaving the ice above and below as clean and pure as any other. It is very notable and significant that the ice next the debris layers is the firmest and most perfect that the glacier affords. The coarser debris is arranged in the same horizons with the fine silt and clay. . . . . . Where ice is well laminated, as it commonly is, the laminations bend under and over the embedded boulders. This seems to indicate that the embedded boulders do not descend through the ice by virtue of superior gravity, but are retained in the original position given them by the embedding process. The extent to which the basal portion of the ice is laminated is remarkable. In selected cases twenty laminations might be counted to the inch. These laminations are sometimes symmetrical, straight and parallel. At other times they are undulatory, and in instances they are greatly curved and contorted in an intricate fashion."

It was observed that the debris bearing layers were parallel to the base of the glacier and were confined to its lower 50 or 75 feet, with some few exceptions. Even at the border of the glacier clean layers of white ice above the debris strata constituted one-third or more of the section. This is contrary to the view that the debris habitually works up to the surface and forms a layer there as it nears the border of the glacier.

Prof. Chamberlain was fortunate in being able to observe the process of introduction of debris in progress. At a point in the Gable glacier there was found an embossment of rock over which the ice was forced to pass and in so doing to rise in a dome-like fashion. One side of the dome was melted away, revealing operations at its base. Combining a number of observations, the author gives the following interpretation of the process:

"The bottom layer of the ice in passing over the crest of the embossment would be pressed with exceptional force upon it, and would, as a result, be especially liable to detach fragments from it and imbed them within itself. If debris were being pushed or dragged along between the ice and the rock surface beneath, it would be pressed into the ice and the ice compacted about it with exceptional force. As any given portion of the basal layer passed beyond the crest of the embossment, the vertical pressure would tend to cause it to follow down the lee slope, while the horizontal thrust of the moving ice would tend to force it straight forward. If any given portion yielded to the first and passed down the slope, it would produce a curve in the hardened basal layer of ice. As a result of this, the horizontal thrust, instead of continuing to act along the disadvantageous curved line, and against the superior friction of the bottom, would be disposed to cause the layer to buckle at the bend. The fold so formed would be elongated and appressed by the continuation of the process and become a layer. The ice, beneath, however, would gradually yield, and the debris layer would settle down out of the line of maximum thrust and the conditions for a new fold be induced."

Cases of true faulting and overthrust were seen, the rocky debris being carried along the fault plane.

As to the method of movement, Prof. Chamberlin presents evidence, which taken in connection with the intrusion and interstratification of earthy material, would seem to indicate that these glaciers move, in some notable part at least, by the sliding of one layer upon another.

Several instances were noted where the glaciers had advanced over their terminal moraines by riding up over them, but none where the ice showed any competency to push the frontal material, even its own debris, before it.

A driftless area was discovered on the east side of Bowdoin Bay immediately adjoining the present great ice-cap. (Bull. Geol. Club, Phila., 1895.)

BOTANY.[1]

New Species of Fungi.—The activity of our fungologists is indicated by the long lists before us which have been published within the last few months. From the Proceedings of the Academy of Natural Sciences of Philadelphia (1895, pp. 413 to 441) we have "New Species of Fungi from Various Localities," by J. B. Ellis and B. M. Everhart, including ninety-nine species. Many of these are from Colorado and other western regions. We note among the more interesting species the following, viz.: *Fomes alboluteus*, from an altitude of 10,000 feet, in Colorado; *Bovista cellulosa*, *Lycoperdon alpigenum*, both from Colorado, the latter from an altitude of 11,500 feet; *Rosellinia geasteroides* from Louisiana; *Phyllachora plantaginis*, parasitic on *Plantago rugelii*, in Wisconsin.

The same authors publish in the October (1895) *Bulletin of the Torrey Botanical Club*, a paper on "New Species of Fungi" in which there are described eight new species from the Sandwich Islands, eleven from Florida, and six from Mexico. It is with much pleasure that we observe that but two of the specific names are dedicated to persons, viz.: *Schizophyllum egelingianum* (probably a synonym for *S. commune*) and *Melogramma egelingii* from Mexico. It is to be hoped that the good example here set may be followed by others upon whom it falls to find names for new species.

In the Fourth Report of the Botanical Survey of Nebraska, just issued, fifty-five new species of fungi are described by Roscoe Pound, F. E. Clements and C. L. Shear. These are distributed as follows: in the *Mucoraceæ*,1; *Sphærioideæ*, 1; *Mucedinaceæ*, 2; *Dematiaceæ*, 2; *Stilbaceæ*, 1 (in the new genus *Trichurus* of Clements and Shear); *Tuberculariaceæ*, 2; *Helvellaceæ*, 2, *Pezizaceæ*, 24; *Bulgariaceæ*, 1; *Agari-*

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[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.